Wes-2020-01

General

- Overall, the paper is very interesting in terms of the wind simulation work and comparison of wind simulation to data. The loads simulation is quite interesting – in particular figure 10 and the related discussion. The figures gemerally are quite interesting and overall the work is a nice contribution. However, the overall paper structure is weak and undermines the value of the paper to the wind research community. Paper should be restructured around the scientific question at hand rather than procedural description
    - "goal section" should be integrated to the introduction and expanded in terms of motivation
    - Methods description that appears distributed through introduction, section 3, and sections 4.1, 4.2 and 4.3, and section 5 should be moved to a formal methods section with the overall study scientific approach discussed before introduction of the wind simulation results
    - Two results sections:
        - Wind simulation and validation
        - Aero-elastic simulation and code to code comparison
    - Conclusions and recommendations
- Abstract needs a rewrite
- Consider having an editor (besides me) review for grammar and flow of the paper
- The use of bullet lists is far too liberal and in many places takes away from the paper flow and doesn't make sense (i.e. in the conclusion)
- More detailed comments by section are provided below

Abstract

- The abstract needs to be rewritten. It should succinctly describe what is interesting about the current work in terms of novelty and scientific value. It is currently descriptive and "unconventional wind conditions" is very vague. What does this mean? What about BEM modelling accuracy did you learn? What were the key findings of the work?
- Do not state in the abstract the organizations involved, it is irrelevant and evident already in the author list

Introduction

- The paper lacks a proper motivation. Why is this interesting? Why should a reader care? What is the problem that this article is trying to solve?
- First sentence is awkward. Recommend for example: "This article investigates the loading of an offshore 10 MW wind turbine in response to extreme wind events in the North Sea."
    - Generally, the article could do with a clean-up for grammar, flow and readability

- Lack of explanation of the use of the LES model and its validation – this is likely in the cited paper but it would be good to explain why this data set is being used for this study and what about its use will lead to novel insights
- The entire discussion from line 27 to line 37 reads more like a methods section except lacking in detail.
- "conventional procedure along the IEC standards" is vague
- This is the objective of the paper and should be elevated and an introduction properly motivate the objective: "By comparing the loads in response to the extreme events with those from the conventional design load spectrum, the importance of extreme wind events can be assessed for practical (load) purposes."
- Git rid of the bullets and write the paper outline in paragraph form as is the convention

Goal

- Please consider removing the section and integrating with the introduction. Either that, or retitle the section though the first option is preferable.
- The first bullet is a code mechanics and not scientific contribution. Rephrase or eliminate.
- The second bullet is the main paper contribution and should be elevated. Everything in the paper should be structured around this. It should be moved to the introduction along with a contextual discussion of why site-specific analysis like this would be necessary versus following the IEC standard approach. Also why its not already done in practice should be discussed as well and then how this paper provides a first step towards enabling site-specific analysis for x, y, z purposes.
- The third bullet is important as well – can we rely on BEM for accurately assessing loading like we would see in such conditions as explored here? Elaborate on why the code comparison is being done.
- Delete: "Hence it should be realized that, apart from demonstrating the combined GRASP-PHATAS tool," – this is not a scientific contribution
- Rewrite the last paragraph of this section – the two are absolutely related if the overarching objective is the investigation of loads assessment in realistic site-specific offshore environmental conditions

Reference turbine and location

- Too many scientifically irrelevant details about the AVATAR project in the first paragraph – if necessary to include, do so via a footnote
- The low induction concept is not well explained. Is this relevant for the current study? In what way? While many readers likely know what this is, it is not ubiquitously understood and merits further explanation
- Many of the details of the design would be better stated in a table form rather than sentence form – it will save space and be more digestible
- The mast and site location are introduced without proper motivation – was the mast data used for validation at some point? Is the mast of particular importance to this paper? If so how? All of this could be better described if integrated into a methods section (see general comments)

Calculation of loads for extreme events

- Line 126-127 – how were these events identified? Was all this work with GRASP and LES part of this study? If so, it should be properly discussed in terms of the validation – a single plot (figure 2) seems quite limited and there is no discussion of it. If not, please reference other literature where this has been done more thoroughly.
- While using the site data is quite interesting, it is unclear if the year chosen is quite representative as extreme events might occur in other years – why was this year selected? Is it representative of the extreme conditions the turbine will face? What are the limitations of the approach? (it is very cool work, but the discussion is currently lacking)
- How were the "extreme" cases selected? Can you discuss a bit more how you came to select these? How do they compare with what the standard would recommend?
- "For the selected LLJ case the corresponding observed wind profile does not show a jet-like profile." Can you discuss or explain?
- Figure 4 is really great. I would like to see a bit more discussion:
    - Can you explain at all the mismatch between observations and simulations for the different cases?
    - When indicating that the conditions show presence of a LLJ, please provide more detail as to how – it will not be apparent to many readers.
    - What are the closest DLCs in the standard for each of these cases or where would you expect to see them surface in IEC standard analysis? There are a couple of comments linking the cases to the standard but it could be further developed
    - "In contrast, for the LLJ case the observed values of TI do increase with height, which would be much harder to explain. " – please try…
- ERA5 analysis is presented but not really discussed at all – either exclude it or refer to it in discussions
- Line 208: Can you define climatology – i.e. change to: "In this section, we move from comparison of isolated 10-minute records to the climatology, (climatology definition), of extreme wind events from the GRASP LES versus the MMIJ observations." Generally it refers to the study of changing climate over time, but I don't think that is how you are using it here.
- Line 214: Can you explain why GRASP fairs better in capturing strong veer than ERA5?
- Line 236: ERA5 underestimates speed of LLJ – why? And what does GRASP do differently that enables it to better capture these events?
- Line 250 – somewhat irrelevant details about code history- footnote it – better would be to describe model approach for aero-elastic analysis – modal? Multi-body?
- There are a lot of improvements to BEM beyond the works cited in lines 259. As BEM / vortex comparison is a key part of the study, I suggest an elaboration on this and its inclusion in the methods section rather than here sandwiched between wind simulation analysis results and aeroelastic analysis results
- The whole section of 4.2 is methods versus results – it is recommended to move to methods section
- Will the AWSM model serve as "truth" here?
- No need to have a separate section 4.3, it can be part of the prior discussion of the overall approach to the aeroelastic simulations and also should be moved to a methods section

Calculation of reference design load spectrum

- Move this entire section into the methods section as a subsection
- “almost complete set of design cases” is vague
- It is unclear that you are redoing this analysis or just reusing the results of the prior referenced study (i.e. TurbSim is mentioned in 4.3 for Whiffle input and SWIFT in 5 for IEC).

Comparison between aero-elastic loads at extreme events with loads from the reference spectrum

- This section could be significantly improved and restructured by focusing first on the whiffle based simulation results and comparison of BEM and AWSM. Then move on to the standard and comparison.
- Isn’t it more common to use the terminology flapwise than flatwise?
- For figures 8 and 9, consider removing the line for the reference andjust having the dots
- Im not sure why bullets are used in lines 317 to 331 as the comments do not seem to have a common point of relation. They are simply continued discussion of the results and would be better in paragraph form.
- The entire comparison in figures 8 and 9 seems a bit odd – its an apples to oranges situation. It would be good perhaps to separate the figures out and show the loads from the whiffle input data first and then from the standards analysis second. It would be better to see in the first case, the differences between BEM and vortex for the cases and a discussion as to why differences surface.
- The overall DEL comparison is a struggle
    - How are the DELs calculated in each case and is this really apples to apples? A fair comparison?
    - The absolute values in the tables are hard to interpret except for the fact that for DLC1.2 they are much higher than for LLJ and then for BEM to AWSM respectively… is there a better way to present this data?
    - Based on this study, do you think the study is really overly considered or if more site data were taken (over a much longer time period) would we see loading closer to DLC 1.2?
- In section 6.1 the use of bullets is again a bit odd. Also, some of the discussion seems to be tied to the prior table and figures and some to figure 10, why is this a separate sub-section?
- Figure 10 and discussion is interesting and well-discussed. Makes more sense than the discussion related to figures 8 and 9 and subsequent table
- Redundant section 6.1 title for accuracy. Again, does this need to be a subsection? I would move this discussion further up and discuss it where the data for BEM versus AWSM is shown in figures
- For lines 398-401, is there evidence of this in the results that you have? Are these commonly believed explanations ones from the cited papers?

Conclusions and recommendations

- Get rid of the bullets

- Emphasize the scientific learnings. Anything code related is a support element to enable the analysis
- Lines 434 to lines 439 – this is a much better description of what this paper is about than anything written prior to. Pull some of this into the introduction and abstract
- Line 438-439 – what is the value of doing the simulations based on physical wind models? This is a key aspect of the paper but it is not properly motivated anywhere
- Future work should be the last paragraph
- Author contributions and acknowledgements should be footnote or its own section